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Hitachi Solution for the SAP HANA Platform in a Scale-up Configuration using Hitachi Advanced Server DS7160

Reference Architecture Guide

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Revision history

	Changes	Date
MK-SL-185-07	▪ Support for RHEL 9.2	July 2024
MK-SL-185-06	▪ Support for SLES 15 SP5 ▪ Support for RHEL 8.8	November, 2023
MK-SL-185-05	▪ Support for SLES 15 SP4 ▪ Support for RHEL 8.6	February, 2023

Reference Architecture Guide

Use this reference architecture guide to implement SAP HANA in a scale-up configuration for Hitachi Solution for the SAP HANA Platform on Hitachi Advanced Server DS7160 using Second Generation Intel Xeon Scalable Processors scaling-up from 8 socket to 16 socket configurations. This document covers the following deployments:

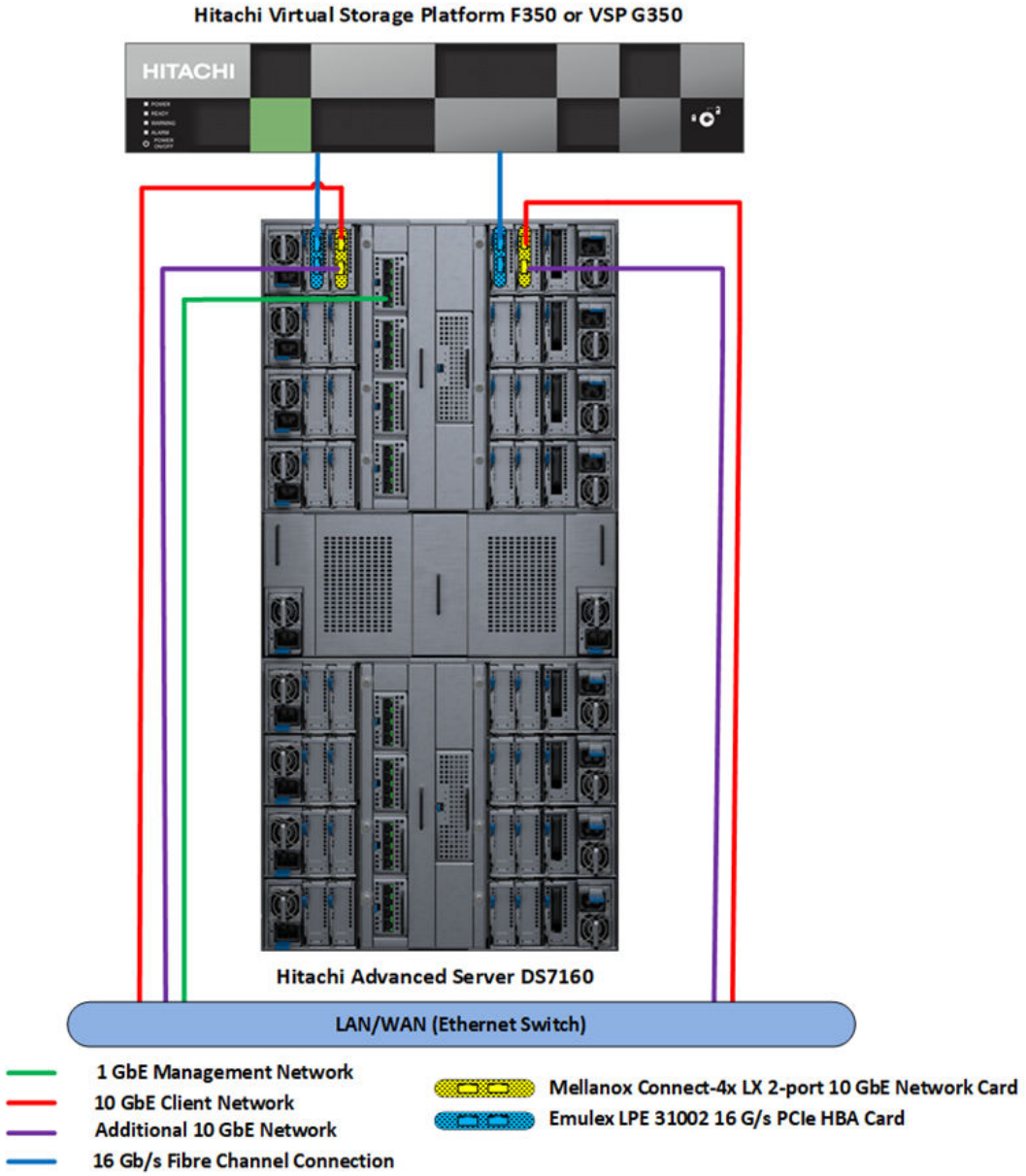
- SAP HANA appliance With a SAP HANA appliance deployment, the hardware vendor pre-assembles, pre-installs, and pre-configures the hardware and software, with the complete package certified by SAP

This solution uses the following components:

- Hardware
  - One Hitachi Advanced Server DS7160 using external node controller
  - External subsystem storage Hitachi Virtual Storage Platform F350 (VSP F350) or VSP G350
- Software
  - Preconfigured SAP HANA to provide a converged solution for applications using the SAP HANA Platform

The validation of this environment with external storage uses Hitachi Virtual Storage Platform VSP F350 or VSP G350. Your needs may require other storage options and fall under a Tailored Datacenter Integration (TDI) solution. Contact your account representative for details and implementation services whenever you require using external storage.

The following figure shows the topology of this reference solution using external drives on a Hitachi Virtual Storage Platform VSP F350 or VSP G350 storage subsystem.



This Hitachi Solution for SAP HANA is a preconfigured converged system for any business workload running on the SAP HANA Platform. It is ready to plug in to your network to host business data, deliver data-driven insights throughout your business, and predict real-time outcomes.

At this time only configurations without Intel Optane DC persistent memory are supported. CPU and memory configurations without Intel Optane DC persistent memory are listed in the following table.

Number of Sockets	RAM Size
8 × Intel Xeon Platinum 8276, 8276L, 8280, or 8280L processors using Hitachi Advanced Server DS7160	▪ 6144 GB with 96 × 64 GB 2933 RDIMM-DR
8 × Intel Xeon Platinum 8276L or 8280L processors using Hitachi Advanced Server DS7160	▪ 6144 GB with 48 × 128 GB 2933 LRDIMM-QR ▪ 9216 GB with 48 × 64 GB and 48 × 128 GB 2933 LRDIMM-QR ▪ 12288 GB with 96 × 128 GB 2933 LRDIMM-QR
10 × Intel Xeon Platinum 8276, 8276L, 8280, or 8280L processors using Hitachi Advanced Server DS7160	▪ 7680 GB with 120 × 64 GB 2933 RDIMM-DR
10 × Intel Xeon Platinum 8276L or 8280L processors using Hitachi Advanced Server DS7160	▪ 7680 GB with 60 × 128 GB 2933 LRDIMM-QR ▪ 11520 GB with 60 × 64 GB and 60 × 128 GB 2933 LRDIMM-QR ▪ 15360 GB with 120 × 128 GB 2933 LRDIMM-QR
12 × Intel Xeon Platinum 8276, 8276L, 8280, or 8280L processors using Hitachi Advanced Server DS7160	▪ 9216 GB with 144 × 64 GB 2933 RDIMM-DR
12 × Intel Xeon Platinum 8276L or 8280L processors using Hitachi Advanced Server DS7160	▪ 9216 GB with 72 × 128 GB 2933 LRDIMM-QR ▪ 13824 GB with 72 × 64 GB and 72 × 128 GB 2933 LRDIMM-QR ▪ 18432 GB with 144 × 128 GB 2933 LRDIMM-QR
14 × Intel Xeon Platinum 8276, 8276L, 8280, or 8280L processors using Hitachi Advanced Server DS7160	▪ 10752 GB with 168 × 64 GB 2933 RDIMM-DR
14 × Intel Xeon Platinum 8276L, or 8280L processors using Hitachi Advanced Server DS7160	▪ 10752 GB with 84 × 128 GB 2933 LRDIMM-QR ▪ 16128 GB with 84 × 64 GB and 84 × 128 GB 2933 LRDIMM-QR ▪ 21504 GB with 168 × 128 GB 2933 LRDIMM-QR

Number of Sockets	RAM Size
16 × Intel Xeon Platinum 8276, 8276L, 8280, or 8280L processors using Hitachi Advanced Server DS7160	▪ 12288 GB with 192 × 64 GB 2933 RDIMM-DR
16 × Intel Xeon Platinum 8276L, or 8280L processors using Hitachi Advanced Server DS7160	▪ 12288 GB with 96 × 128 GB 2933 LRDIMM-QR ▪ 18432 GB with 96 × 64 GB and 96 × 128 GB 2933 LRDIMM-QR ▪ 24576 GB with 192 × 128 GB 2933 LRDIMM-QR

Note: L type processors are required for 128 GB DIMM use.

This technical paper assumes that you have familiarity with the following:

- Storage area network (SAN) based storage systems
- General storage concepts
- Common IT storage practices
- SAP HANA

Note: Testing of this configuration was in a lab environment. Many things affect production environments beyond prediction or duplication in a lab environment. Follow the recommended practice of conducting proof-of-concept testing for acceptable results in a non-production, isolated test environment that otherwise matches your production environment before your production implementation of this solution.

Key solution elements

The following are the key hardware and software components used in this reference architecture.

Note: Do not change the layout of any of the components in this environment without consulting your Hitachi Vantara account representative. Changing this layout can require manual configuration of the network or using different components.

Hardware elements

The following table lists the hardware used to deploy this specific scale-up configuration of Hitachi Solution for SAP HANA for the different sized solutions.

Hitachi Advanced Server DS7160 uses an external storage subsystem, as listed in the following table.

Hardware	Quantity	Configuration	Role

Hitachi Advanced Server DS7160 using external node controller (XNC)	1	▪ Supported CPUs:
		  • Intel Xeon Platinum 8276, or 8276L processors, 28-core, 2.20 GHz, 152 W
		  • Intel Xeon Platinum 8280, or 8280L processors, 28-core, 2.70 GHz, 205 W
		▪ UBOX Enterprise
		▪ 16-socket connecting box
		▪ 2 heat sinks CPU 0/1
			SAP HANA server

Mellanox Technologies MT27710 Family [ConnectX-4 Lx]	2	▪ Mellanox Connectx4 dual port PCIe card per compute module	For SAP HANA 10 GbE client network and additional 10 GbE network
	2	▪ Cisco SFP+ 3M Twinaxial cables	
16 Gb/s Fibre Channel Dual HBA LPe31002 M6 Blade	2	▪ 2-port LPE31002-M6 16 Gb/s card per compute module	Connectivity to the external storage subsystem
	4	16 Gb/s SFP	
Hitachi Virtual Storage Platform VSP F350 or VSP G350	1	▪ 1 pair of controllers ▪ 1 pair 4-port 14 Gb/s channel blades	Block storage

Hardware	Quantity	Configuration	Role
		▪ 1 expansion DBS drive box ▪ 128 GB Cache ▪ 1 pair SAS ports ▪ 1 pair PSUs ▪ 3.8 TB SSD (the number of drives varies for different memory sizes).	
Cisco Nexus 92348 or 3048 switch	1	▪ 48 × 1 GbE ports	Optional switch for management network
Cisco Nexus 93180YC-FX or 93180YC-EX switch	2	▪ 48 × 10 GbE ports	Optional switches for client network or additional backup network
Minkels V2 Rack	1	▪ 1 standard rack	Optional rack for mounting the server
PDUs	6	▪ Vertical PDUs	Optional PDUs for the solution

Software elements

The following table lists the software products used to deploy this solution.

Software	
Operating system	SUSE Linux Enterprise Server for SAP Applications
	Red Hat Enterprise Linux Server for SAP Applications
Database	SAP HANA

Solution design

The detailed design for this scale-up configuration of Hitachi Solution for the SAP HANA Platform for this reference solution includes the following:

- Hitachi Advanced Server DS7160 configuration (on page 9)
- Network architecture configuration (on page 11)
- Storage configuration (on page 13)
- SAP HANA configuration (on page 21)
- Tuning recommendations (on page 22)

Hitachi Advanced Server DS7160 configuration

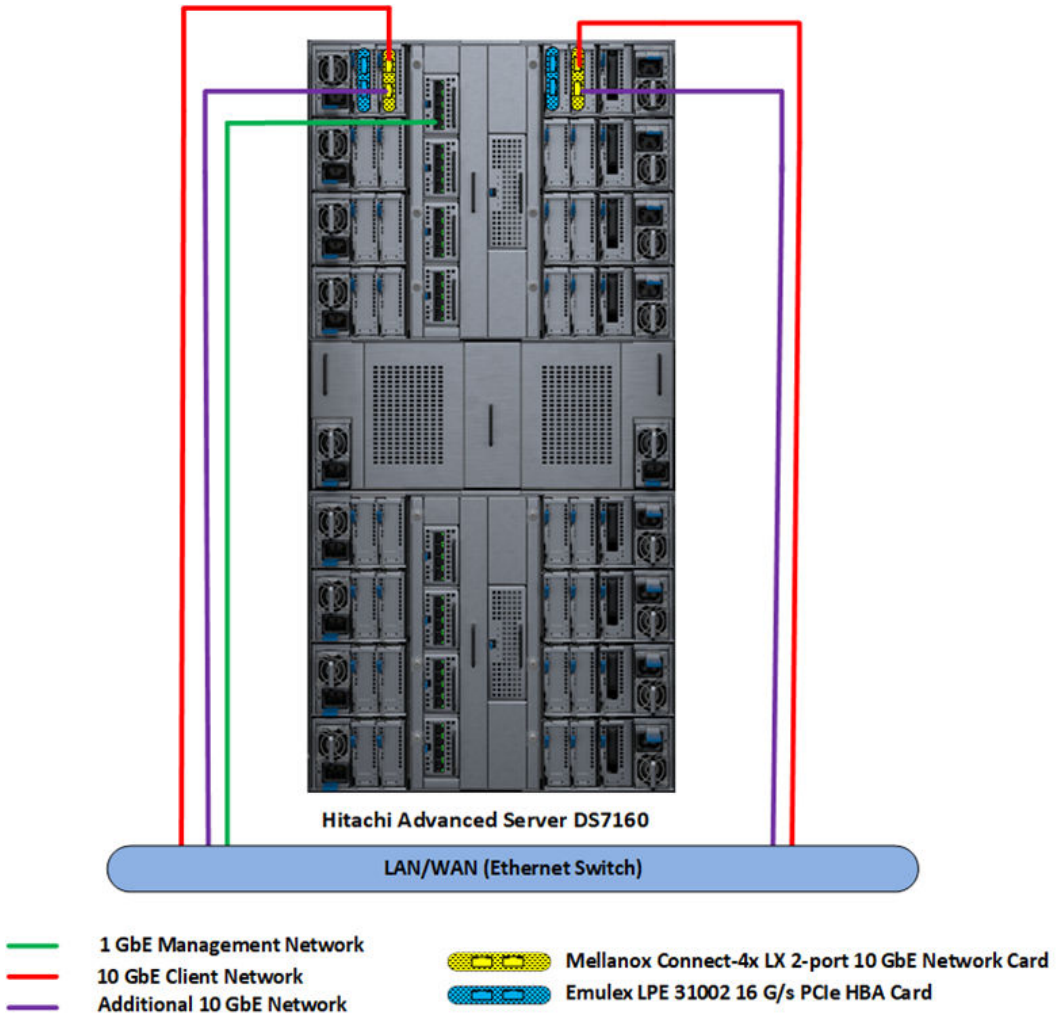
The basic building block for Hitachi Advanced Server DS7160 includes the following:

- 2 × 8 socket compute boxes each hosting up to 4 compute modules.
  - Compute Box is the base element of the Hitachi Advanced Server DS7160 in an 8U form factor hosting one 2-socket module per 2U.
- UBOX Enterprise for 16 sockets.
  - The UBOX is a 5U chassis imbedding several UPI Node Controllers (UNC). The UNC is designed and developed for Intel processor-based servers. It is a VLSI-type (Very Large-Scale Integration) integrated circuit derived from mainframe technologies and tuned for High Performance Computing. This innovative and unique technology makes it possible to interconnect up to eight 2-socket modules allowing to go up to 16-socket SMP systems in a Cache Coherent Non-Uniform Memory Access (CCNUMA) architecture.
  - UBOX Enterprise is the standard configuration providing all-to-all topology between CPUs. It provides both the performance and the high availability needed for high memory demanding applications like SAP HANA.
- 16-socket connecting box.
  - A Connecting Box assembles modules within a single Compute Box, on the rear, with no apparent cabling.
- Compute modules that include the following:
  - 2 processors using one of the following:
    - 28-core: 8276 or 8276L
    - 28-core: 8280 or 8280L
  - 12 memory DIMMs per CPU, 24 per compute module.
  - 5 I/O blades for PCIe adapters.
  - 4 native 1 GbE Ethernet ports.

The following figure shows the Hitachi Advanced Server DS7160 with 8 socket, 10 socket, 12 socket, 14 socket and 16 socket compute modules. As shown, the compute module on the top 8 socket compute box acts as master module and other identical modules can be added as slaves to add more resources.

Network architecture configuration

Connect the 1 GbE management port of Hitachi Advanced Server DS7160 to a Cisco Nexus 92348 or 3048 switch or to any other external 1 GbE switch for management connectivity, as shown in the following figure.



Make the following 10 GbE network connections for SAP HANA nodes as shown in the following table.

- Connect the following to Cisco Nexus 93180YC-FX or 93180YC-EX switches or to any other external switches:
  - Port 0 of 10 GbE Mellanox Connect-4x LX PCIe card to two different Cisco Nexus 93180YC-FX or 93180YC-EX switches.
  - Bond the corresponding two ports, eth9901 and eth9902, as bond0 at the operating system level using active-active network bond mode with the following options:

    ```
    mode= 802.3ad miimon=100 xmit_hash_policy=2 lacp_rate=fast
    ```

    This acts as the client network for the SAP HANA node.
- If additional 10 GbE network connections are required, connect Port 1 of both 10 GbE Mellanox Connect-4x LX PCIe cards to the Cisco Nexus 93180YC-FX or 93180YC-EX switches or to any other external switches.
- For all sizes, PCIe Slots 1 and 3 of the master module are used to create a bond. All other slots and ports can be used at the customer's discretion.

Network card	Port	Network description
PCIe_Slot_1 of Master Module	0	Client network for the SAP HANA node (eth9902).
	1	Free for use as additional 10 GbE network for backup, SAP HANA system replication, or other purposes.
PCIe_Slot_3 of Master Module	0	Client network for the SAP HANA node (eth9901).
	1	Free for use as additional 10 GbE network for backup, SAP HANA system replication, or other purposes.

Note: The management network and client network can be on the same network switch or a separate network switch, depending on the network environment.

Storage configuration

These are the components you need to implement a scale-up SAP HANA system with Hitachi Advanced Server DS7000 using Hitachi Virtual Storage Platform F350 or VSP G350:

- 2 × 2-port Emulex LPE31002-M6 16 Gb/s PCIe HBA cards
- 1 Hitachi Virtual Storage Platform F350 or VSP G350
- Storage drive box trays (DBS)
- Spare drives

For a direct connection between Hitachi Virtual Storage Platform F350 or Virtual Storage Platform G350 and the Emulex HBA on Advanced Server DS7000, use System Mode 847 on the storage to enable the following host mode options (HMO) for the corresponding storage port connected to the server:

- Use System Mode 847 on the storage array.
- Enable Host Mode Option 02, Host Mode Option 94, and Host Mode Option 109 for the corresponding storage port connected with the server.
  - Host Mode Option 109

    This option fixes the SAN boot issue, where sometimes the system cannot find the Boot LUN after a restart.
  - Host Mode Option 94

    This option is mandatory for direct connection between the Hitachi Virtual Storage Platform and the Emulex Lpe31002 HBA to work. Without setting up Host Mode Option 94, SAN storage cannot be identified from the Emulex HBA.
  - Host Mode Option 02 (Optional)

    This option is recommended when the system uses test-unit-ready (TUR) for path_checker in the /etc/multipath.conf file. Also Host Mode Option 02 is typically used when fencing technology is used.
- Host Group ID must be 00 for SAN boot.

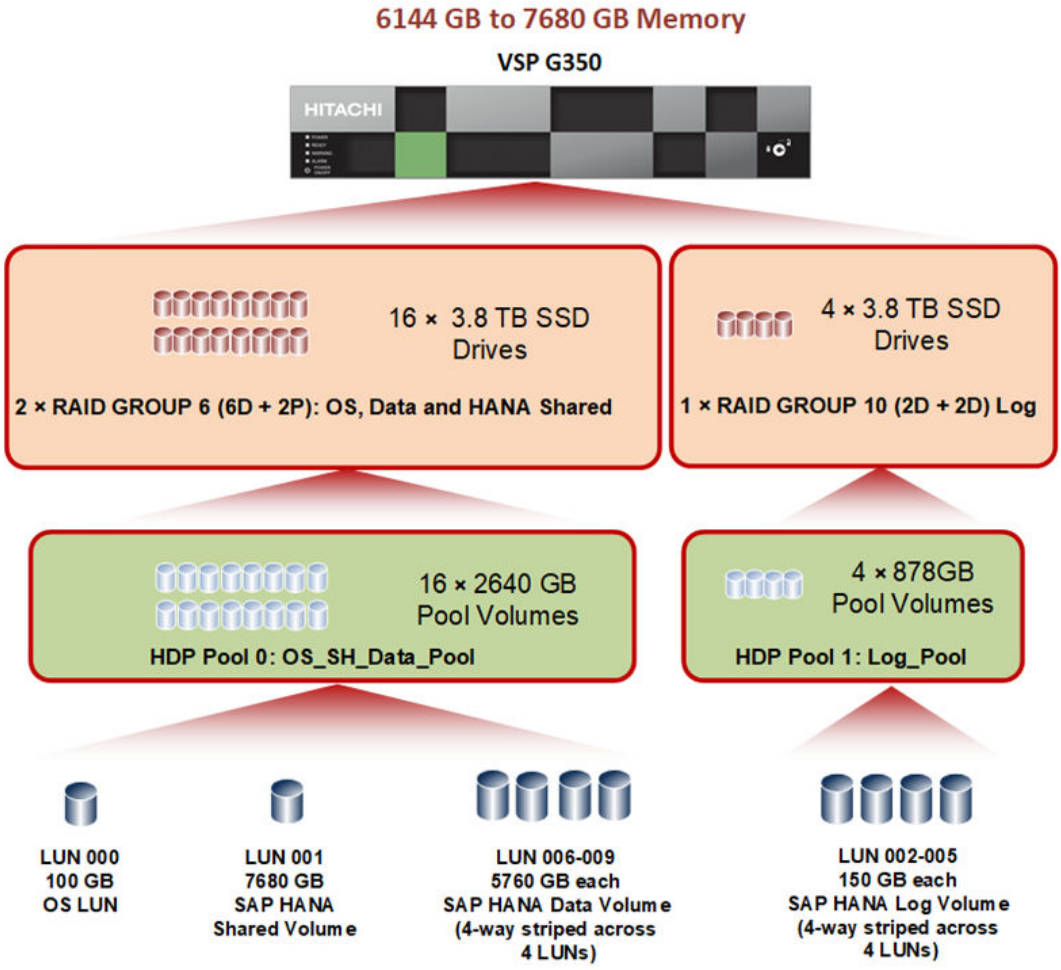
Use the port properties listed in the following table.

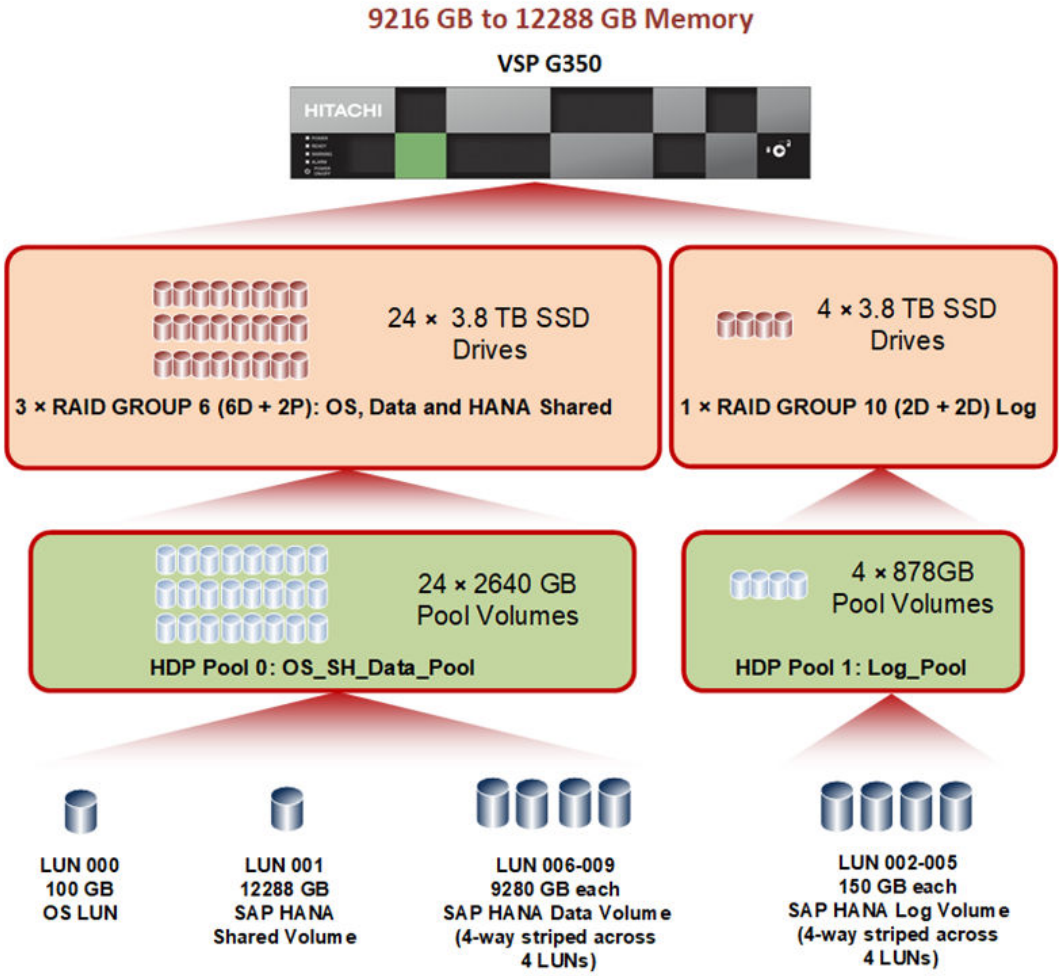
For this setting	Use this value
Port Security	Disabled
Port Speed	16 Gbps
Fabric	OFF
Connection Type	P-to-P

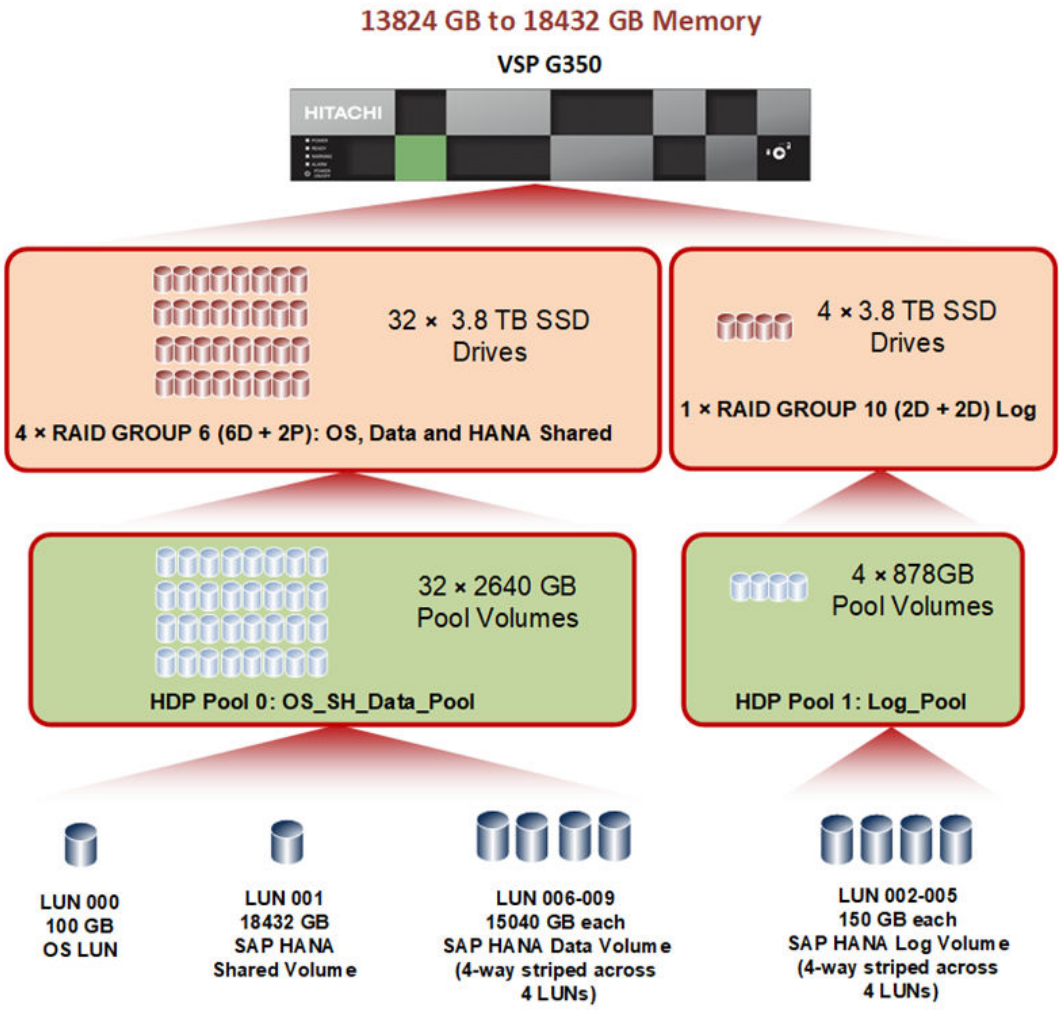
The storage configuration includes the following for different sizes:

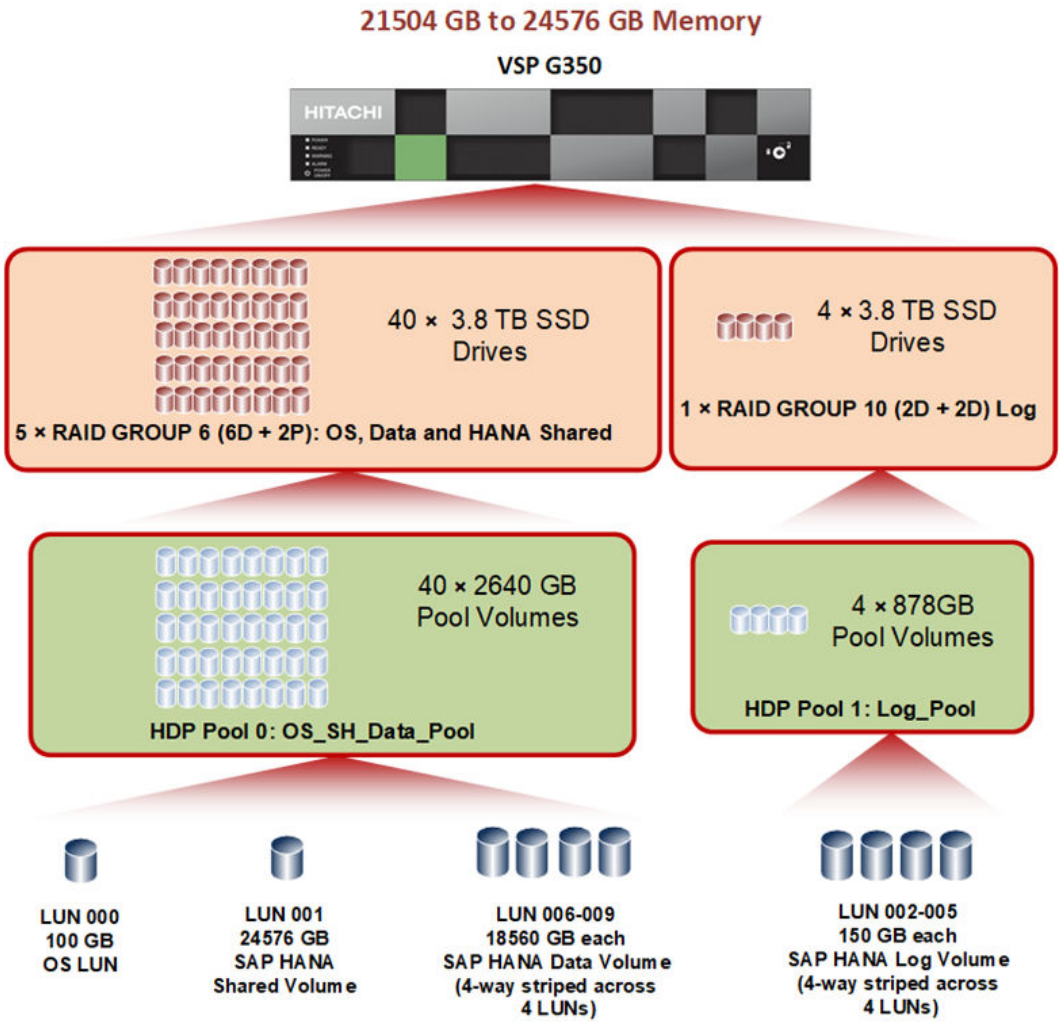
- Operating system volume (OS)
- SAP HANA shared volume (/hana/shared)
- SAP HANA log volume (/hana/log)
- SAP HANA data volume (/hana/data)

The following figures show the storage configuration for different memory sizes.




9216 GB to 12288 GB Memory
VSP G350
HITACHI
24 × 3.8 TB SSD Drives
3 × RAID GROUP 6 (6D + 2P): OS, Data and HANA Shared
4 × 3.8 TB SSD Drives
1 × RAID GROUP 10 (2D + 2D) Log
24 × 2640 GB Pool Volumes
HDP Pool 0: OS_SH_Data_Pool
4 × 878GB Pool Volumes
HDP Pool 1: Log_Pool
LUN 000
100 GB
OS LUN
LUN 001
12288 GB
SAP HANA
Shared Volume
LUN 006-009
9280 GB each
SAP HANA Data Volume
(4-way striped across
4 LUNs)
LUN 002-005
150 GB each
SAP HANA Log Volume
(4-way striped across
4 LUNs)


13824 GB to 18432 GB Memory
VSP G350
HITACHI
32 × 3.8 TB SSD Drives
4 × RAID GROUP 6 (6D + 2P): OS, Data and HANA Shared
4 × 3.8 TB SSD Drives
1 × RAID GROUP 10 (2D + 2D) Log
32 × 2640 GB Pool Volumes
HDP Pool 0: OS_SH_Data_Pool
4 × 878GB Pool Volumes
HDP Pool 1: Log_Pool
LUN 000
100 GB
OS LUN
LUN 001
18432 GB
SAP HANA
Shared Volume
LUN 006-009
15040 GB each
SAP HANA Data Volume
(4-way striped across
4 LUNs)
LUN 002-005
150 GB each
SAP HANA Log Volume
(4-way striped across
4 LUNs)



This solution uses a dynamic provisioning pool design for the storage layout that ensures maximum utilization and optimization at a lower cost. Hitachi Storage Virtualization Operating System with Hitachi Dynamic Provisioning uses storage-based virtualization layered on top of RAID technology (RAID on RAID) to enable virtual LUNs (dynamically provisioned volumes) to draw space from multiple pool volumes. This improves storage utilization.

Two pools are enough to provide storage and throughput for all supported storage sizes, as listed in the following table.

- Use Pool 0 to create virtual volumes (vVols) for the operating system, data, and shared binaries. You can add additional parity groups and pool volumes to increase the size of Pool 0 to support larger memory configurations.
- Use Pool 1 to create virtual volumes for HANA log.

Dynamic provisioning pool name	Purpose	Parity group RAID level and disks
OS_SH_Data_Pool	Operating system LUN SAP HANA shared LUN Data LUN	RAID-6 (6D+2P) on 3.8 TB SSD drives
Log_Pool	Log LUN	RAID-10 (2D+2D) on 3.8 TB SSD drives

The example used for SAP HANA certification is minimal storage configuration on Hitachi Virtual Storage Platform F350 or VSP G350 in a scale-up appliance solution for SAP HANA with sizes ranging from 6144 GB to 24576 GB memory. The following tables provide details for:

- Logical devices layout
- Virtual volume for SAP HANA node
- LUN path assignment

Dynamic provisioning pool	Parity group ID	Parity group RAID level and disks	LDEV ID	LDEV name	LDEV size (GB)	MPU assignment
OS_SH_Data_Pool	1	RAID-6 (6D+2P) on 3.8 TB SSD drives	00:00:01	OS_SH_DA_Pool_1	2640	MPU-10
			00:00:02	OS_SH_DA_Pool_2	2640	MPU-20
			00:00:03	OS_SH_DA_Pool_3	2640	MPU-10
			00:00:04	OS_SH_DA_Pool_4	2640	MPU-20
			00:00:05	OS_SH_DA_Pool_5	2640	MPU-10
			00:00:06	OS_SH_DA_Pool_6	2640	MPU-20
			00:00:07	OS_SH_DA_Pool_7	2640	MPU-10
			00:00:08	OS_SH_DA_Pool_8	2640	MPU-20
	2	RAID-6 (6D+2P) on 3.8 TB SSD drives	00:00:09	OS_SH_DA_Pool_9	2640	MPU-10
			00:00:10	OS_SH_DA_Pool_10	2640	MPU-20
			00:00:11	OS_SH_DA_Pool_11	2640	MPU-10
			00:00:12	OS_SH_DA_Pool_12	2640	MPU-20

Dynamic provisioning pool	Parity group ID	Parity group RAID level and disks	LDEV ID	LDEV name	LDEV size (GB)	MPU assignment
			00:00:13	OS_SH_DA_Pool_13	2640	MPU-10
			00:00:14	OS_SH_DA_Pool_14	2640	MPU-20
			00:00:15	OS_SH_DA_Pool_15	2640	MPU-10
			00:00:16	OS_SH_DA_Pool_16	2640	MPU-20
Log_Pool	2	RAID-10 (2D+2D) on 3.8 TB SSD drives	00:01:01	Log_Pool_1	878	MPU-10
			00:01:02	Log_Pool_2	878	MPU-20
			00:01:03	Log_Pool_3	878	MPU-10
			00:01:04	Log_Pool_4	878	MPU-20

Dynamic provisioning pool	Virtual volume ID	Virtual volume name	Virtual volume size	MPU assignment
OS_SH_Data_Pool	00:02:00	HANA_OS	100 GB	MPU-10
	00:02:01	HANA_SH	7680 GB	MPU-20
Log_Pool	00:02:02	HANA_LOG_1	150 GB	MPU-10
	00:02:03	HANA_LOG_2	150 GB	MPU-20
	00:02:04	HANA_LOG_3	150 GB	MPU-10
	00:02:05	HANA_LOG_4	150 GB	MPU-20

Dynamic provisioning pool	Virtual volume ID	Virtual volume name	Virtual volume size	MPU assignment
OS_SH_Data_Pool	00:02:06	HANA_DATA_1	5760 GB	MPU-10
	00:02:07	HANA_DATA_2	5760 GB	MPU-20
	00:02:08	HANA_DATA_3	5760 GB	MPU-10
	00:02:09	HANA_DATA_4	5760 GB	MPU-20

LUN ID	LDEV ID	LDEV name
0000	00:02:00	HANA_OS
0001	00:02:01	HANA_SH
0002	00:02:02	HANA_LOG_1
0003	00:02:03	HANA_LOG_2
0004	00:02:04	HANA_LOG_3
0005	00:02:05	HANA_LOG_4
0006	00:02:06	HANA_DATA_1
0007	00:02:07	HANA_DATA_2
0008	00:02:08	HANA_DATA_3
0009	00:02:09	HANA_DATA_4

SAP HANA configuration

This describes how to configure SAP HANA in this solution.

File system

The implementation of this solution uses an external storage subsystem:

- BTRFS Filesystem
  - Operating system volume (SLES only)
- XFS Filesystem for DRAM only
  - Operating system volume (RHEL only)
  - SAP HANA shared volume
  - Data volume
  - Log volume

Device-mapper multipath

This solution uses device-mapper multipath to consolidate the multiple connections coming from external storage subsystems.

SAP HANA software installation

After configuring the file system for the SAP HANA data volume and log volume, install the SAP HANA software on DS7160 systems with 8 sockets or more. These systems must use the minimum required HANA 2.0 SPS04 Revision 48.01 (or newer) and for HANA 2.0 SP05 Revision 52 (or newer) software.

Install the following SAP HANA software components on the server:

- Database
- Client

Tuning recommendations

For information regarding the permitted DS7160 systems with more than 8 sockets for SAP HANA 2.0 in production and recommended hyper threading settings based on the actual customer workload such as Online Analytical Processing (OLAP), Online Transactional Processing (OLTP) and mixed workloads, refer to the following SAP Notes:

- SAP Note 2954473

  SAP HANA on Hitachi Vantara DS7160 with more than 8 sockets

- SAP Note 2711650

  SAP HANA on Intel server systems with more than 8 CPUs / sockets

DS7160 systems with 8 or more sockets must be designed and validated together with a Hitachi Vantara expert taking the following into account:

- The individual customer workload
- The application KPIs
- Projected growth assumptions

Contact saphanaexpertsizing@hitachivantara.com for large scale sizing guidance and an optimized system configuration.

We also highly recommend testing the initially sized system with all workload scenarios thoroughly before putting the system into production. Hitachi Vantara will work with customers to ensure that these requirements are met.

BIOS settings and tuning for appliances using Cascade Lake processors

For optimum performance of the Hitachi Advanced Server DS7160 using Cascade Lake CPUs, configure BIOS settings recommended in the DS7000 release notes.

Engineering validation

The test methodology for validating the appliance configuration using Hitachi Advanced Server DS7160 with DRAMs on enterprise storage configuration with Hitachi Virtual Storage Platform F350 or VSP G350 used the following:

- SAP HANA Hardware and Cloud Measurement Tools HCMT-046_0 was tested on these volumes for SLES 15 SP1:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools HCMT-046_0 was tested on these volumes for SLES 15 SP2:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools HCMT-060_0 was tested on these volumes for SLES 15 SP3:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools HCMT-065_0 was tested on these volumes for SLES 15 SP4:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools HCMT-073_0 was tested on these volumes for SLES 15 SP5:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools HCMT-047_0 was tested on these volumes for RHEL 7.6:
  - Data volume
  - Log volume

- SAP HANA Hardware and Cloud Measurement Tools HCMT-053_0 was tested on these volumes for RHEL 8.1:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools HCMT-053_0 was tested on these volumes for RHEL 8.2:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools HCMT-060_0 was tested on these volumes for RHEL 8.4:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools HCMT-065_0 was tested on these volumes for RHEL 8.6:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools HCMT-073_0 was tested on these volumes for RHEL 8.8:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools HCMT-078_0 was tested on these volumes for RHEL 9.2:
  - Data volume
  - Log volume

For optimal use of SAP HANA database, use the parameters listed in the sample *global.ini* files for SUSE Linux Enterprise Server and Red Hat Enterprise Linux Server. Follow SAP Note 2399079 to set up the parameters defined in the *global.ini* file for SAP HANA 2.0.

Sample SUSE Linux Enterprise Server global.ini file

The following is a sample global.ini file configured and used for validation on the SUSE Linux Enterprise Server 15 SP1, SP2, SP3, SP4, and SP5 solutions:

```
[communication]
tcp_backlog = 2048

[fileio]
max_parallel_io_requests[data] = 128
max_submit_batch_size[data] = 64
size_kernel_io_queue[data] = 512
async_read_submit[data] = on
async_write_submit_blocks[data] = all
min_submit_batch_size[data] = 16
async_write_submit_active[data] = on
max_parallel_io_requests[log] = 128
max_submit_batch_size[log] = 64
size_kernel_io_queue[log] = 512
async_read_submit[log] = on
async_write_submit_blocks[log] = all
min_submit_batch_size[log] = 16
async_write_submit_active[log] = on

[multidb]
mode = multidb
database_isolation = low
singletenant = yes

[persistence]
basepath_datavolumes = /hana/data/HIT
basepath_logvolumes = /hana/log/HIT
```

Sample Red Hat Enterprise Linux Server global.ini file

The following is a sample global.ini file configured and used for validation on the Red Hat Enterprise Linux Server 7.6, 8.1, 8.2, 8.4, 8.6, 8.8, and 9.2 solutions:

```
[communication]
tcp_backlog = 2048

[fileio]
max_parallel_io_requests[data] = 128
max_submit_batch_size[data] = 64
size_kernel_io_queue[data] = 512
async_read_submit[data] = on
async_write_submit_blocks[data] = all
min_submit_batch_size[data] = 16
async_write_submit_active[data] = on
max_parallel_io_requests[log] = 128
max_submit_batch_size[log] = 64
size_kernel_io_queue[log] = 512
async_read_submit[log] = on
async_write_submit_blocks[log] = all
min_submit_batch_size[log] = 16
async_write_submit_active[log] = on

[multidb]
mode = multidb
database_isolation = low
singletenant = yes

[persistence]
basepath_datavolumes = /hana/data/HIT
basepath_logvolumes = /hana/log/HIT
```

Product descriptions

The following products are used in this solution.

Hitachi Advanced Server DS7000 series

To take advantage of the latest developments in artificial intelligence (AI), data analytics and machine learning, you require an infrastructure with high reliability, extreme performance, and agile scalability. Hitachi Advanced Server DS7000 series servers deliver this with a unique modular architecture.

Your server can be configured and scaled to meet the needs of a wide variety of application workloads. This can be used from in-memory data analytics processing to virtualization and hybrid cloud.

The Advanced Server DS7000 series has several complementary models, each based on the Intel Xeon scalable processor. You can upgrade a model to the next model, preserving your hardware and software investment as your business grows.

Hitachi Virtual Storage Platform F Series family

Use Hitachi Virtual Storage Platform F series family storage for a flash-powered cloud platform for your mission critical applications. This storage meets demanding performance and uptime business needs. Extremely scalable, its 4.8 million random read IOPS allows you to consolidate more applications for more cost savings.

Hitachi Virtual Storage Platform F series family delivers superior all-flash performance for business-critical applications, with continuous data availability.

Hitachi Virtual Storage Platform G series family

The Hitachi Virtual Storage Platform G series family enables the seamless automation of the data center. It has a broad range of efficiency technologies that deliver maximum value while making ongoing costs more predictable. You can focus on strategic projects and consolidating more workloads while using a wide range of media choices.

The benefits start with Hitachi Storage Virtualization Operating System RF. This includes an all new enhanced software stack that offers up to three times greater performance than our previous midrange models, even as data scales to petabytes.

Hitachi Virtual Storage Platform G series offers support for containers to accelerate cloud-native application development. Provision storage in seconds, and provide persistent data availability, all the while being orchestrated by industry leading container platforms. Move these workloads into an enterprise production environment seamlessly, saving money while reducing support and management costs.

SAP HANA

SAP HANA converges database and application platform capabilities in-memory to transform transactions, analytics, text analysis, predictive and spatial processing so businesses can operate in real-time. This combines database, data processing, and application platform capabilities in a single in-memory platform. Also, the platform provides libraries for predictive, planning, text processing, spatial, and business analytics — all on the same architecture. This architecture comes from leading hardware partners of SAP, including Hitachi Vantara.

By eliminating the divide between transactions and analytics, SAP HANA allows you to answer any business question anywhere in real time.

As an SAP customer, you can download more information, including the following:

- SAP HANA Master Guide

  This is the central starting point for the technical implementation of SAP HANA. Use this guide for basic concepts and for planning.

- SAP HANA Server Installation and Update Guide

  This guide provides an overview of how to install and update an SAP HANA system with the SAP HANA lifecycle management tools.

- SAP HANA Administration Guide

  This guide explains how to configure, manage, maintain, and optimize your SAP HANA installation using SAP HANA administration tools.

SAP HANA hardware directory provides information about SAP HANA appliances certified by SAP hardware partners.

Operating system options for SAP HANA

SUSE Linux Enterprise Server for SAP Applications and Red Hat Enterprise Linux for SAP HANA are available operating systems when running SAP HANA.

- SUSE Linux Enterprise Server (SLES) for SAP Applications

  Compete more effectively through improved uptime, better efficiency, and accelerated innovation using SUSE Linux Enterprise Server for SAP Applications. This is a versatile server operating system for efficiently deploying highly available enterprise-class IT services in mixed IT environments with performance and reduced risk.

  SUSE Linux Enterprise Server was the first Linux operating system to be certified for use with SAP HANA. It remains the operating system of choice for most SAP HANA customers.

- Red Hat Enterprise Linux (RHEL) for SAP HANA

  Using the stability and flexibility of Red Hat Enterprise Linux for SAP HANA, reallocate your resources towards meeting the next challenges instead of maintaining the status quo. Deliver meaningful business results by providing exceptional reliability and military-grade security. Use Enterprise Linux to tailor your infrastructure as markets shift and technologies evolve.

Changing the configuration settings is only supported along the guidelines of SAP and the operating system distributor and may otherwise cause significant performance problems. The following SAP Notes for SUSE Linux Enterprise Server and Red Hat Enterprise Linux are a good starting point for information on this topic:

- 1944799 - SAP HANA Guidelines for SLES Operating System Installation
- 2009879 - SAP HANA Guidelines for Red Hat Enterprise Linux (RHEL)

For more details, see "Updating and Patching the Operating System" by searching in the "View SAP HANA document" from Technical Information and Best Practices.

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